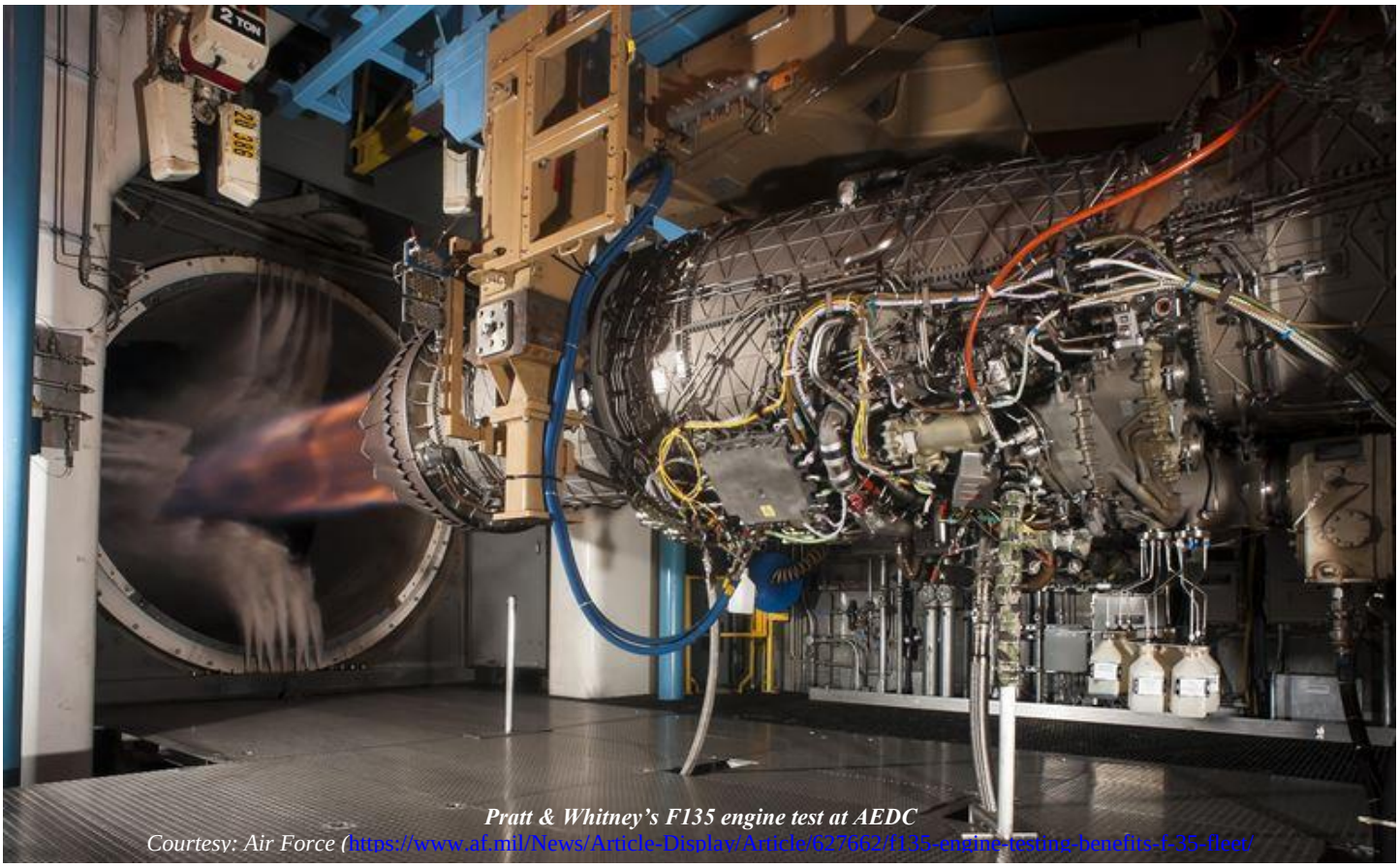
San José State University
Aerospace Engineering
AE167 – Aerospace Propulsion – Spring 2019



Pratt & Whitney's F135 engine test at AEDC
Courtesy: Air Force (https://www.af.mil/News/Article-Display/Article/627662/f135-engine-testing-benefits-f-35-fleet/

Instructor:	Prof. Fabrizio Vergine
Office Location:	E272B
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Office Hours:	Tuesday and Thursday: 3:00pm – 4:15pm Friday: 10:00am – 11:30am
Class Days/Time:	Tuesday and Thursday / 12:00pm – 1:15pm
Classroom:	Boccardo Business Center 004
Prerequisites:	"C" or better in AE160 and AE164

Faculty Web Page and MYSJSU Messaging

Course materials such as syllabus, handouts, notes, assignment instructions, etc. can be found on the Canvas Leaning Management System course login website at http://sjsu.instructure.com. You are responsible for regularly checking with the messaging system through MySJSU at http://my.sjsu.edu.

Course Description

Overall performance characteristics of propellers, ramjets, turbojets, turbofans, rockets. Performance analysis of inlets, exhaust nozzles, compressors, burners, and turbines. Rocket flight performance, single-/multi-stage chemical rockets, liquid/solid propellants and design problems.

Course Goals

Introduce students to the basic principles and design of:

- *Air-breathing propulsion systems.*
- *Space propulsion systems.*

Course Learning Outcomes (CLO)

Upon successful completion of this course, students will be able to:

1) *Perform a thermodynamic analysis of turboprop, turbojet and turbofan engines.*
2) *Analyze the performance of subsonic and supersonic inlets.*
3) *Analyze the performance of combustors, afterburners and exhaust nozzles.*
4) *Analyze the performance of axial flow compressors and turbines.*
5) *Carry out flight performance calculations for rockets.*
6) *Analyze the performance of solid and liquid rockets.*

Course Relationship to BSAE Program Outcomes

	1	2	3	4	5	6	7
Learning Outcomes							
1 – 6	++	+++	O	O	+++	O	O

+: Skill level 1 or 2 in Bloom's Taxonomy
++: Skill level 3 or 4 in Bloom's Taxonomy
+++: Skill level 5 or 6 in Bloom's Taxonomy
O: Skill addressed but not assessed

Required Texts/Readings

Textbook

Mattingly, J.D., Elements of Propulsion Gas Turbines and Rockets, AIAA Education Series, ISBN 1563477793

Other Readings

Instructor's notes posted on Canvas. Additional research material may be required for the completion of various assignments.

Course Requirements and Assignments

Approximately 50% of the course will be taught using a flipped classroom approach. Lecture plans and instructions will be provided to the students ahead of time. As part of this approach, students are required to be prepared for class as any activity during a flipped lecture will count towards the final grade.

Short Quizzes

Individual effort. Short quizzes (5min-10min) will be given at the beginning of class during each flipped lecture.
Rules:

- *Only the students who are present in class will have the opportunity to take the quizzes.*
- *No make-up short quizzes will be granted.*

Workout Assignments

Group/individual effort. Part of these assignments will be solved by groups of 4 students, part will be solved individually. Group workouts will take place during every flipped lecture under the supervision of the instructor.
Rules:

- *All the students in a group must be present in class and contribute to the work; members of the group that are not present will not receive a grade in the group part of the workout.*
- *The final grade on a workout may not be the same for all the members of the group: part of the workout will be solved individually at home and turned in on Canvas as a separate document.*
- *The 75% of the earned grade in each workout will be coming from the group work, the remaining 25% will come from the individual assignment.*
- *No make-up workouts will be granted.*

Quizzes

Individual effort. Approximately 4 or 5 quizzes will be given during the course. The dates of the quizzes will be communicated in class a few days in advance.
Rules:

- *No make-up quizzes will be granted. Exceptions may be made (but not guaranteed!) if it is provided a written and signed justification from a third party (i.e., work supervisor, doctor, etc.).*

Design Project

Group effort. Student groups will solve an assigned open-ended design problem and will present their work at the end of the semester.
The final report which will be due on the last day of class must include:

- *Description of the rationale.* Must include a clear and thorough description of all the steps taken toward the solution of the whole assignment. Every design choice must be justified through explanations with solid theoretical foundations.
- *Results.* Plots and graphs must be commented and professionally presented. Missing units, labels and illegible images will not be graded.
- *Conclusions.*

"Success in this course is based on the expectation that students will spend, for each unit of credit, a minimum of 45 hours over the length of the course (normally 3 hours per unit per week with 1 of the hours used for lecture) for instruction or preparation/studying or course related activities including but not limited to

internships, labs, clinical practica. Other course structures will have equivalent workload expectations as described in the syllabus."

Grading Information

- ***Short Quizzes*** *10%*
- ***Workout Assignments*** *30%*
- ***Quizzes*** *45%*
- ***Design Project***
  - *Final Report* *12%*
  - *Presentation* *3%*

A plus	> 97%
A	93% - 97%
A minus	90% - 92%
B plus	88% or 89%
B	83% - 87%
B minus	80% - 82%
C plus	78% or 79%
C	73% - 77%
C minus	70% - 72%
D	60% - 69%
F	< 60%

Classroom Protocol

No cellphone use is permitted in class. Respect for others is required and expected.

University Policies

Per University Policy S16-9, university-wide policy information relevant to all courses, such as academic integrity, accommodations, etc. will be available on Office of Graduate and Undergraduate Programs' Syllabus Information web page at http://www.sjsu.edu/gup/syllabusinfo/.

AE Department and SJSU policies are also posted at http://www.sjsu.edu/ae/programs/policies/

Course Schedule

As the instructor of the course I reserve the right to make changes to the schedule below as needed.

Week	Date	Topics, Readings, Assignments, Deadlines
1	01/24	**Introduction** - Brief historical background. - Classification of aerospace engines.
2	01/29 – 01/31	**Review of aerothermodynamics for engine analysis** - I and II law of thermodynamics. - Thermodynamic cycles. - Control volume analysis.
3	02/05 - 02/07	**Aircraft gas turbine engine** - Uninstalled and installed thrust. - Gas turbine engine components. - Joule-Brayton cycle.
4	02/12 - 02/14	**Parametric cycle analysis of ideal engines** - Turbojet. - Turbojet with afterburner.
5	02/19 - 02/21	**Parametric cycle analysis of ideal engines** - Turbofan.
6	02/26 - 02/28	**Parametric cycle analysis of ideal engines** - Ramjet.
7	03/05 - 03/07	**Component Performance Analysis** - Subsonic inlets.
8	03/12 - 03/14	**Component Performance Analysis** - Supersonic inlets.
9	03/19 - 03/21	**Component Performance Analysis** - Compressors.
10	03/26 - 03/28	**Component Performance Analysis** - Turbines.
11	04/09 - 04/11	**Component Performance Analysis** - Combustors and Nozzles.
12	04/16 - 04/18	**Parametric cycle analysis of real engines** - Turbojet. - Turbojet with Afterburner.
13	04/23 - 04/25	**Rocket Propulsion** - Thrust equation. - Equation of motion for an accelerating rocket.
14	04/30 - 05/02	**Rocket Propulsion** - Multi-stage rockets.
15	05/07 - 05/09	**Rocket Propulsion** - Liquid propellant rocket engines. **Project's final report is due on May 09.**
Final Exam	Monday, May 20	**Project presentations (additional days to present the work will be communicated in class)** Boccardo Business Center 004, from 09:45pm to 12:00pm